

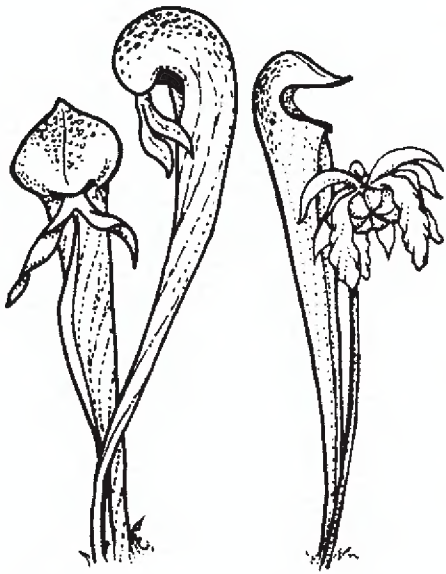
CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society

Volume 46, No. 4

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CARNIVOROUS PLANT NEWSLETTER

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Front Cover: Flowering plants of *Pinguicula australandina* from Sierra Nevada, Chilean Andes, growing at about 1670 m a.s.l. Photo by Oliver Gluch. Article on page 121.

Back Cover: *Heliamphora* 'Patasola' plant and flowers. Photo by Butch Tincher. Article on page 157.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Advertisers should contact the editors. Views expressed in this publication are those of the authors, not the editorial staff.

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International Carnivorous Plant Society, Inc.
2121 N. California Blvd., Suite 290
Walnut Creek, CA 94596-7351, USA
icps@carnivorousplants.org

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Marcel van den Broek, marcel@carnivorousplants.org
Richard Nunn, richardnunn@carnivorousplants.org
Keith Becker, keith@carnivorousplants.org
Ryan Ward, ryan@carnivorousplants.org
Alex Eilts, Conservation Director, alex@carnivorousplants.org
Jan Schlauer, Cultivar Registrar, jan@carnivorousplants.org
Bob Ziemer, bob@carnivorousplants.org
Carolyn Becker, carolyn@carnivorousplants.org
John Brittnacher, john@carnivorousplants.org
Chad Williams, chad@carnivorousplants.org
Joe Griffin, joe@carnivorousplants.org
editor@carnivorousplants.org
Bob Ziemer
Barry Rice
Karl Herold
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12TH INTERNATIONAL CARNIVOROUS PLANT SOCIETY CONFERENCE

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I am beyond delighted to announce that the Bay Area Carnivorous Plant Society and California Carnivores will co-host the 2018 ICPS conference with help from the San Diego CPS and the Los Angeles CPS!

Please come join us August 3-5, 2018, in Santa Rosa, California, tucked in the heart of beautiful Sonoma County. This area is renowned for its lovely scenery, mild weather, and culinary excellence. It is against this backdrop that we hope to provide what will be a once in a lifetime carnivorous plant event!

This is truly the golden age of carnivorous plants and we hope to highlight that with almost 3 full days of lectures on the cutting edge of CP discovery, taxonomy, and cultivation. The conference will begin with an opening presentation from Peter D'Amato, author of "The Savage Garden" and founder of California Carnivores. Be sure and bring your books and get them autographed by Peter! The line-up of presenters is still being put together, but we already have some illustrious names confirmed including: Stewart McPherson, Fernando Rivadavia, Greg Bourke, Larry Mellichamp, Andreas Fleischmann, Naoki Tanabe, and Ulrike Bauer.

The BACPS will be running a special expanded two-day Show and Sale in conjunction with the conference. This includes a judged plant show full of beautifully grown plants from our members and vendors with lots of plants for sale. It is our goal to have as many actual plants on display as possible.

An academic poster event will be held for speakers and other scientists to present their work.

On Sunday, after the presentations wrap up, you will be shuttled a short drive to California Carnivores for a catered banquet dinner. Imagine dining amidst our internationally recognized carnivorous plant collection with other experts and enthusiasts from around the world.

Monday after the conference will be a free day for everyone. California Carnivores will be an open house for those who want to spend more time there, but San Francisco is only an hour away for those with family who might be sick of carnivores by then.

Field trips leave Tuesday morning, August 7, for *Darlingtonia* country! The cobra plant is one of the most charismatic and animalistic of all carnivorous plants and yet it has been seen by relatively few because of its far-flung range. They are definitely worth the four-hour drive North! For starters, you'll see the full diversity of color and forms that live in Del Norte Co., California. You'll see rocky cliffs with hundreds of *Pinguicula macroceras* subsp. *nortensis* clinging to them like tiny starfish. *Drosera rotundifolia* will be present at several sites as well. We plan to end our excursion with Eight Dollar Mountain in Southern Oregon; a spectacular site where *Darlingtonia* grow from the river up most of the mountain. You'll be in good company too with such illustrious travel companions including Barry Rice, Peter D'Amato, and myself.

I love these conferences because they are a rare opportunity to gather with people from all over the world who are passionate about my passion. I always leave with new friends and appreciation for the plants that I love so much. Please come and be a part of carnivorous plant history.

There will soon be a webpage for registration with more info. If you're interested in presenting or volunteering, please email info@californiacarnivores.com.

REVISION OF *PINGUICULA* (LENTIBULARIACEAE) IN CHILE AND ARGENTINA

OLIVER GLUCH • Im Gebel 6 • 67376 Harthausen • Germany • pinguicula@gluch.info

Keywords: new species, *Pinguicula antarctica*, *Pinguicula australandina*, *Pinguicula chilensis*, *Pinguicula nahuelbutensis*.

Abstract: The distribution range of *Pinguicula chilensis* is revised and it is shown that the type specimen represents *P. antarctica* and not the high Andean taxon erroneously treated under the name *P. chilensis* by most recent authors. The latter is therefore named as a new species, *P. australandina*, with a different type. Populations from the Cordillera de Nahuelbuta, Chile, formerly likewise included in *P. chilensis*, are described and illustrated as a new distinct species and key differences to the most closely related species *P. antarctica* and *P. australandina* are shown.

Introduction

Until now, six butterwort species have been described from South America (Lampard *et al.* 2016). While *Pinguicula elongata* belongs to the tropical-heterophyllous growth type, forming two distinct sets of leaves, the five other species *P. calyptata*, *P. involuta*, *P. jarmilae*, *P. chilensis*, and *P. antarctica* belong to the tropical-homophyllous growth type, which means that the plants form only one set of leaves all year round. Especially the two southernmost butterwort species in South America, *P. chilensis* (*sensu* Clos 1849; Ernst 1961; Casper 1966) and *P. antarctica*, are occurring in habitats that are characterized by cold winters with long periods of frost, that the plants survive as open rosettes of carnivorous leaves, often covered under snow.

During several visits to locations of butterwort populations assigned to *P. chilensis* in the Nahuelbuta mountain range west of the city of Angol, Araucanía region, Chile, and the Sierra Nevada mountain range in the Andes south-east of Curacautín, Araucanía region, Chile, the author was able to study plants *in situ* during and after flowering. Although the author considered those populations as belonging to *P. chilensis* in the past (Gluch 2007), more detailed studies of field data and data from cultivated specimens revealed that the populations in the Cordillera de Nahuelbuta had several characters different from the plants from the Andes, which themselves differ significantly from the description of *P. chilensis* given by Clos (1849). This initiated a more detailed study of herbarium specimens and existing literature.

Discussion

1. Revision of taxonomic status and distribution of *P. chilensis* in South America

In 1849 Clos described in his part of Claudio Gay's publication about the Chilean flora (Clos 1849) a new butterwort species that he named *Pinguicula chilensis* Clos which was different from the already known butterwort species *Pinguicula antarctica* Vahl occurring in Chile. In his protologue, Clos mentioned that the new species occurs in bogs of the Valdivian coastal mountain range and that in January the flowering had already finished. Therefore, he did not describe any characters of the flower itself ("corolla ...") and he also did not give any details about sizes of different parts of the plant.

In his revision of the genus *Pinguicula*, Ernst (1961) was not questioning Clos' hypothesis and gave a more detailed description of the characters of the 2-lipped corolla, including the conical, 2-3 mm long spur, and the 2-parted palate located at the base of the middle lobe of the lower lip (characters that differentiate the flower easily from *P. antarctica*). For the flower scape, he mentioned that the size varies between 2 and 5 cm (compared to 2.5-12 (20) cm for *P. antarctica*). The distribution range of *P. chilensis* was indicated as "central Chile".

In Casper's monograph of the genus *Pinguicula* (Casper 1966), Casper was also referring to herbarium specimens that he studied. Casper had not seen Clos' type from Chile, but he had examined other original material from the Valdivian mountain range, which is located in the herbarium of the Musée Nationale d'Histoire Naturelle in Paris, France (*Gay 169*, (P-photo!)). He also studied specimens from Volcan Llaima in the Chilean Andes, from the Puyehue pass in the Andes (Chilean-Argentinian border region), a location about 540 km further south, and from several locations from the Nahuel Huapi National Park region in Argentina. He had not studied any specimen from the Nahuelbuta coastal mountain range at that time. Casper concluded about the distribution of *P. chilensis*, that along the coastal mountain range of central Chile, *P. antarctica* still occurred in the mountains on the island of Chiloé, while further north, from the Valdivian coastal cordillera on, only *P. chilensis* was present. For the Andes, Casper (1966) mentioned the southernmost distribution of *P. chilensis* at about 41° southern latitude and the northernmost area at about 38° southern latitude. In his monograph, he was just following for *P. chilensis* what had already been stated by Ernst (1961).

Concerning the habitat of the species, Casper (1966) stated that the most common habitats are wet pastures at the edges of the melting glaciers at elevations of 2000-3000 m a.s.l. in the alpine regions of the Andes, locally called "mallín". Casper further mentioned that *Pinguicula chilensis* occurs there together with *Caltha andicola*, *Melandrium cucubaloides*, and *Calandrinia colchaguaensis*.

In Reiche (1907), a detailed description of the vegetation of the plains of the Cordillera Pelada (the higher parts of the Valdivian coastal mountain range, ca. 1000 m a.s.l.) is given. In open, peat-bog-like areas there is a typical Antarctic vegetation consisting of the dominating species *Donatia fascicularis*, *Astelia pumila*, *Sphagnum acutifolium*, and *Tribeles australis*. In between this vegetation, Reiche stated that *Carpha viridis*, *Pinguicula chilensis*, *Acaena pumila*, *Drosera uniflora*, and *Schizaea fistulosa* can be found.

For the higher areas of the Isla Grande de Chiloé (about 800 m a.s.l.), Reiche reported that the vegetation was identical as described for the Cordillera Pelada, with the same typical Antarctic vegetation dominated by *Sphagnum* sp. and *Donatia fascicularis*. But for the Chiloé island he mentioned the presence of *P. antarctica* instead of *P. chilensis*.

In a more recent botanical guide of the Chiloé National Park (Villagran 2002), the occurrence of *P. antarctica* was reconfirmed and also documented by a photograph, that shows a plant in flower, which is without doubt *P. antarctica*.

This Antarctic flora does not fit to the common high Andean habitat of *P. chilensis* described by Casper (1966) and also not the personal observations of the present author in the Chilean Andes and the Cordillera de Nahuelbuta (Nahuelbuta coastal mountain range).

Could the type specimen of *P. chilensis* from the Valdivian Cordillera be *P. antarctica* instead?

Several attempts were undertaken to get access to the holotype voucher of *P. chilensis* from Chile, but without success. Recently Dominguez *et al.* (2017) were trying to locate the holotype in any herbarium collection (as in Casper's publication from 1966 there was no herbarium linked to the holotype cited), but they couldn't find any duplicate and therefore selected the herbarium specimen indicated as "isotype" located in Paris Herbarium (P) as lectotype. So, the author investigated this

specimen from the same collection of Gay (as the voucher contains a handwritten label from Gay indicating the same location and collection date as cited in Casper's publication for the holotype, it indeed seems to represent an isotype). Interestingly, the plant was initially determined by the collector Claudio Gay as *P. antarctica*, but then changed to *P. chilensis*. As the plant does not have any flowers but only flower scapes with open seed capsules (so no details about the flower were given in the original description (Clos 1849)), a clear identification of the species is difficult. But there is one character of the specimen that still could serve as a good indicator to differentiate between the Andean plant and *P. antarctica*, which is the length of the flower scape. From my personal studies in the greenhouse as well as from observations at different habitats, after flowering, the flower scape of the Andean plant (thus far assigned to "*P. chilensis*") only elongates very little, while the flower scape of *P. antarctica* shows a significant elongation from flowering to maturity of the seed capsule, sometimes doubling in length. As a consequence, at seed maturity the flower scape of *P. antarctica* is significantly longer compared to the Andean plants and thus a morphological character to distinguish those two species at this developmental stage. Measurements of the flower scapes of the lectotype specimen from Paris show a length of 9.5 cm. This clearly indicates that the length of the fruiting scape does not fall into the range of the Andean plants ("*P. chilensis*" sensu Ernst 1961 and Casper 1966) and therefore the lectotype of *P. chilensis* in reality represents *P. antarctica*, and as a consequence the name *P. chilensis* Clos has to become a later synonym of *P. antarctica* Vahl. Other names do not seem to exist for the high Andean taxon. Therefore, the author is describing the high Andean taxon formerly known as *P. chilensis* as a new species with a new type specimen.

***Pinguicula australandina* Gluch spec. nov.** (Fig. 1 & Front Cover)

Holotype: Argentina, Provincia de Neuquén, Copahué, 1900 m, 11.1.1965, *S. Schajovskoy, s.n.* (M!).

Description: Perennial herb, forming one set of leaves (homophyllous growth type). **Rosette** consists of (3) 4-6 (8) ovate or obovate leaves. **Leaves** are (12) 14-22 (24) mm long, 8-11 mm wide, having a narrow base. The leaf margin is distally involute for 2/3 the length of the leaf. Leaf color is green, green-brown or yellowish green, showing a brown midrib and brown lateral veins. The upper surface of the leaf is densely covered with stipitate glandular hairs, while the upper surface of the base is clothed in long, white, non-glandular hairs. **Flowering** period starts in January and ends beginning of March. Plants form 1-2 erect flower **scapes**, each 2-5 cm long and moderately covered with short, stipitate glandular hairs, of yellowish to green color towards the base and of reddish-brown color towards the flower, darkening further as the seed capsule matures. The **calyx** is bilabiate, reddish-brown, the three lobes of the upper lip are triangular-lanceolate, with an obtuse to slightly pointed tip, ca. 1.5 mm long and 0.5 mm wide at the base. The two lobes of the lower lip are broadly obovate, obtuse to slightly pointed at the tip, divided by up to 1/2 of their length, 1.5-2.0 mm long, 0.5-0.8 mm wide. The outer surface of the calyx is covered with stipitate glandular hairs. The **corolla** consists of five almost equally-sized lobes, each subcuneate or obovate, and incised by up to 1 mm, of a violet, pinkish or lilac color, often with darker veins at the base of the lobes. The two lobes of the upper lip are 3 mm long, 2.5 mm wide, and the three lobes of the lower lip up to 3.7 mm long and 2.7 mm wide. The corolla tube is almost conical or funnel shaped, white, pale violet or pale lilac, often with parallel pale violet or pale lilac veins on the outside, sparsely covered with short, stipitate glandular hairs. The palate is located 1 mm below the base of the middle lobe of the lower lip inside the tube, and is conical or vesiculose, consisting of 2 parts, 0.5 mm long, 0.5 mm



Figure 1: *Pinguicula australandina*. Plant in flower growing in volcanic debris at the edge of a typical alpine wet pasture in the Sierra Nevada, region Araucanía, Chile, at about 1670 m a.s.l. Note the almost isolobiate pink corolla with the yellow 2-parted palate located in the tube below the middle lobe of the lower lip.

wide, and covered with short, yellow subclavate hairs. Behind the palate are 3 rows of long, white, cylindrical hairs. The walls of the corolla tube are also clothed in long, white hairs. The conical spur is 2-3 mm long, obtuse or slightly pointed at the tip, light green and sometimes brownish-green towards the tube, and sparsely covered with short, stipitate glandular hairs. The **seed capsule** is ovoid.

Etymology: The epithet *australandina* refers to the Southern Andes in Chile and Argentina, where populations of this species do occur.

Another consequence of this study is that the ranges of *P. australandina* and *P. antarctica* must be adjusted. *P. australandina* seems to occur only in the alpine regions of the Andes at elevations between 1400 and 2300 m a.s.l., mainly in alpine wet pastures, between 36° (Laguna del Maule, Chile) and about 41° (Cerro Nireco, Argentina) southern latitude. Possibly the range of the species is extending further south, but accessibility to those regions is very difficult. Currently the following locations are known for *P. australandina* (location information based on Casper (1966), Neger (1897), and personal field observations): **Chile:** región del Maule, Laguna del Maule, ca. 2300 m (personal observations); región de la Araucanía, Curacautín, Volcán Llaima; región de la Araucanía,



Figure 2: *Pinguicula antarctica*. Front view of a flower. The yellow 2-parted palate is located at the base of the middle lobe of the lower lip and the corolla is bilabiate with white colored petals (photo from a cultivated specimen originating from Isla Grande de Chiloé, Chile).

Curacautín, Sierra Nevada, ca. 1670 m (personal observations); región de los Ríos, Osorno, paso Puyehue; **Argentina:** provincia de Río Negro, Parque Nacional Nahuel Huapi, Cerro Nireco; provincia de Río Negro, Parque Nacional Nahuel Huapi, Cerro de la Nubes; provincia de Neuquén, paso de Pino Hachado; provincia de Neuquén, Cerro Campana; provincia de Neuquén, Arroyo los Guemados; provincia de Neuquén, Copahué (see Fig. 3).

Pinguicula antarctica (Fig. 2) occurs from Isla de los Estados (Staten Island) in Argentina, about 54° southern latitude, along the Magellan Strait further north along the Chilean coast, up to the island of Chiloé, and then again further north in the higher part of the Valdivian coastal mountain range (Cordillera Pellada), at about 40° southern latitude (see Fig. 3). The location indicated in the map with a question mark also shown in Casper’s publication (1966), which probably refers to Reiche’s (1907) citation of *P. antarctica*. From the latter description of the vegetation east of lake Tagua Tagua (región de los Lagos, Chile) in the Andes above 1400 m below the snow level, it is very doubtful that this is a location of *P. antarctica*, but might be more likely a location of *P. australandina*, as the vegetation described does not fit to the typical Antarctic flora, where *P. antarctica* normally occurs.

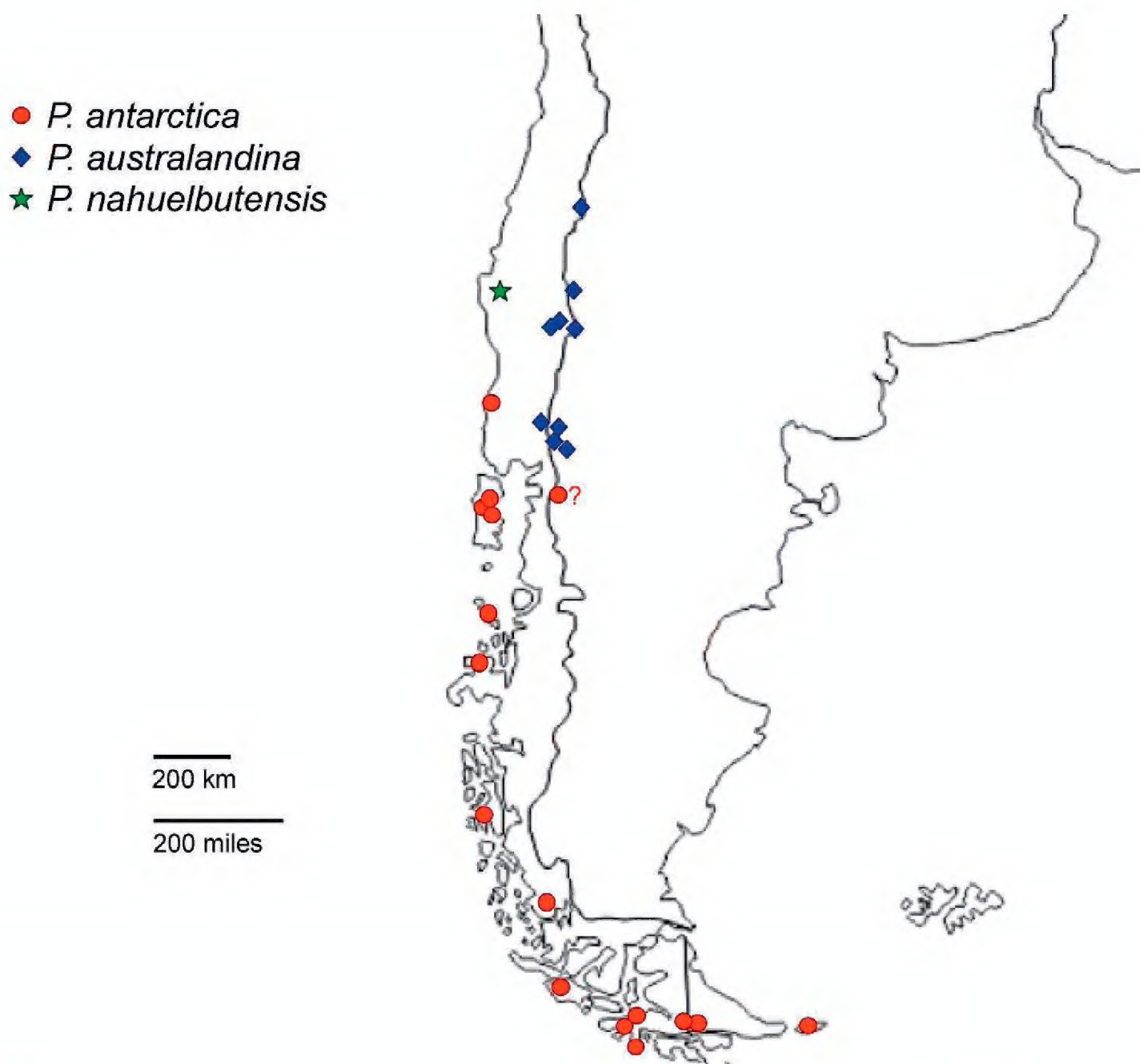


Figure 3: Range of *Pinguicula antarctica*, *P. australandina*, and *P. nahuelbutensis* in the southern part of South America (map based on information from Casper (1966, 1984), Diaz *et al.* (2008), Domínguez (2012), Neger (1897), and personal field observations).

2. Butterwort populations in the Cordillera de Nahuelbuta

In the Chilean Cordillera de Nahuelbuta, Malleco Province, at elevations above 1200 m a.s.l. climatic conditions are comparably similar to the Andean mountains, at seepage or waterlogged areas the vegetation is dominated by typical South American peatbog species like *Donatia fascicularis*, *Astelia pumila*, and *Oreobolus obtusangulus* (Cavieres *et al.* 2005).

During my personal studies, three locations were examined in the Nahuelbuta mountains where *Pinguicula* populations can be found between 1150 and 1250 m a.s.l. In one place that is locally called “las turberas”, the area is characterized by more open grass vegetation dominated by Poaceae and Cyperaceae. They occur amid stagnant or slightly running water accumulating in a depression between the surrounding mountains, in a forest mainly consisting of *Araucaria araucana* and different *Nothofagus* species. In locations with soils having reduced draining capacities, at the edges of moist and shady areas in mostly organic soils, as well as under grass or on open pure organic soil exposed to direct sun, butterwort populations were found. The number of flowers per individual

Table 1. Comparison of different morphological characters of *Pinguicula nahuelbutensis* with its closest related species *P. australandina* and *P. antarctica*.

Morphological character:	<i>P. nahuelbutensis</i>	<i>P. australandina</i>	<i>P. antarctica</i>
Length of flower scape	0.5-1.0 (1.5) cm	2.0-5.0 cm	2.5-12.0 (20.0) cm
Presence of glandular hairs on flower scape	densely covered with stipitate glandular hairs	whole scape moderately covered with stipitate glandular hairs	almost glabrous in the upper part of the scape, towards the base increasing presence of stipitate glandular hairs
Corolla shape	subisolobate to isolobate	subisolobate to isolobate	bilabiate, upper lip shorter than lower lip
Corolla color	white or light violet	pink, lilac, or violet	white
Form and size of spur	1.0-2.5 mm, conical, rounded, or pointed at the tip	2.0-3.0 mm, first half slightly conical, obtuse, or slightly pointed at the tip	1.0-1.5 mm, saccate
Location of palate	at the base of the middle lobe of lower lip	below the middle lobe inside the tube	at the base of the middle lobe of lower lip
Stolons	present	unknown	present

plant seemed to be more numerous compared to the Andean populations of *P. australandina*, maybe due to the longer and warmer vegetation period in the Cordillera de Nahuelbuta.

Two other *Pinguicula* populations were growing at seepage locations in a forest dominated by *Nothofagus dombeyi* and *N. pumilio*. Plants were growing mostly in shade in wet organic soil, often together with different mosses. Under these conditions, plants had exclusively green leaves and were bigger in size compared to the plants growing at the “las turberas” location. In flower, the corolla lobes were showing only a light violet color with few to no darker venation. In January, when the plants are in full flower, numerous seedlings were seen close to the adult plants that must have had emerged from seed produced in the previous year, as at this point no mature seed was present. At all locations, plants were showing very short flower scapes not corresponding to the original description of the former *P. chilensis sensu* Clos (1849). When studying other morphological characters, it became obvious that the butterwort populations in the Cordillera de Nahuelbuta differ in various characters from *P. australandina* as well as from *P. antarctica* (see Table 1). The author therefore proposes to classify the populations of the Cordillera de Nahuelbuta as a distinct new species.

***Pinguicula nahuelbutensis* Gluch spec. nov.** (Figs. 4–7)

Holotype: Chile, región de la Araucanía, Provincia de Malleco, Parque Nacional de Nahuelbuta, 1250 m, 7.1.1968, *Ricardi, Marticorena and Matthei, 1831* (M!)



Figure 4: *Pinguicula nahuelbutensis*. Front view of a flower. The yellow 2-parted palate is located at the base of the middle lobe of the lower lip. (photo from location “las turberas” in the Nahuelbuta National Park, 26 January 2010).



Figure 5: *Pinguicula nahuelbutensis*. Plant with pale violet flower and flower bud (in cultivation). The flower shows a dark violet venation on the outside of the corolla, tube and spur.



Figure 6: *Pinguicula nahuelbutensis*. Lateral view of a flower with pale violet corolla lobes and a white to light yellowish tube (in cultivation). The flower shows almost no venation on the corolla or tube. The lobes of the calyx are divided almost to the base.



Figure 7: *Pinguicula nahuelbutensis*. Stolon with plantlet developing at the base of the leaf rosette (in cultivation).

Other specimens seen: Chile, región de la Araucanía, Provincia de Malleco, Nahuelbuta, 1300 m, 28.10.1987, K.H. & W. Rechinger, 63162 (M!); observations made *in situ* on 3 populations in the Nahuelbuta mountain range on 5 October 2004, 21 January 2005, 8 January 2006, 12 January 2007, and 26 January 2010.

Description: Perennial herb, forming only one set of leaves (homophyllous growth type). **Rosette** consists of 5-8 ovate or obovate **leaves** with a narrow base, obtuse or pointed at the tip, margin involute for 2/3 of its length, green to yellowish, sometimes red brown color with a dark brown to black mid rib and often also red brown colored lateral veins, 14-22 (30) mm long and 8-12 (15) mm wide. The upper surface is densely covered with sessile and stipitate glandular hairs and with, white, non-glandular hairs at the leaf base. **Flowering** starts mid of December and ends beginning of February. Plants form 2-4 (5) erect flower **scapes**, green or green-reddish, only 0.5-1.0 (1.5) cm long, covered with stipitate glandular hairs. **Calyx** bilabiate, green and more reddish-brown towards maturity of the seed capsule, of a lanceolate to triangular form with rounded or slightly pointed tip, moderately covered with stipitate glandular hairs, lobes almost entirely divided to the base. The 3 lobes of the upper lip are 1.5-2.5 mm long and 0.5-1.0 mm at the widest point. The 2 lobes of the lower lip are longer compared to the lobes of the upper lip, 2.5-3.0 mm long and 0.5-1.0 mm wide. **Corolla** subisolobate or isolobate, white to light violet, with pale or darker violet veins at the base, subcuneate or obovate, incised by up to 1 mm, covered with white hairs on the upper side. The 2 lobes of the upper lip are 3-5 mm long and 2.8-3.5 mm wide. The 3 lobes of the lower lip are 3-6 mm long and 3.0-3.5 mm wide. A yellow palate consisting of 2 connected hump-like parts is located at the base of the middle lobe of the lower lip, scarcely covered with yellow hairs. Behind the palate are 3 rows of yellow or white, cylindrical hairs continuing into the tube. The inside walls of the corolla tube are also clothed in long, yellow or white hairs. The corolla tube is conical or funnel-shaped, ventrally depressed, 3-5 mm long, white-yellowish or pale violet with parallel dark violet, pale violet veins on the outside, that often continue into the spur. The conical spur is 1.0-2.5 mm long, rounded or pointed at the tip, of yellow or yellow-green color. **Seed capsule** is ovoid or globose, with the top of the capsule slightly depressed, green or red brown. Plants can form stolons with plantlets developing at the tips of the stolons. Chromosome number is $2n = 16$ (Casper & Stimpert 2009, as "*P. chilensis*").

Etymology: the epithet *nahuelbutensis* is derived from the Nahuelbuta mountain range, where the new species is occurring.

P. nahuelbutensis seems to be endemic to the Cordillera de Nahuelbuta, where the plants occur at elevations of 1150-1250 m a.s.l. at wet seepage locations in *Nothofagus dombeyi* and *N. pumilio* dominated forest or at the edge of more open wet grassland vegetation dominated by Poaceae and Cyperaceae spp. surrounded by *Araucaria araucana* and *Nothofagus* forest.

Pinguicula nahuelbutensis can form stolons with new plantlets at the end of the stolon, which has been observed also for *P. antarctica* (Luhers 2000) as well as for *P. jarmilae* and *P. calyptrata* (Fleischmann 2011), but has not been reported for *P. australandina*.

Pinguicula nahuelbutensis seems to be closely related to *P. antarctica* and *P. australandina*. It differs from *P. australandina* by the much shorter flower scape, the color of the corolla, the form of the spur, the location of the palate, as well as by the formation of stolons. It differs from *P. antarctica* by the much shorter flower scape, the presence of stipitate glands on all parts of the flower scape, by the form of the spur, and by the more subisolobate to isolobate corolla form.

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DROSERA HUEGELII ENDL. VAR. *PHILLMANNIANA*
FROM THE STIRLING RANGE, SOUTH WESTERN AUSTRALIA

YVES-ANDRE UTZ • 33 ch Charles Poluzzi • 1227 Carouge • Switzerland • utz.ya@romandie.com
ROBERT GIBSON • 5 Kristen Close • Cardiff Heights • NSW 2285 • Australia • robert.gibson@
environment.nsw.gov.au

Abstract: Short-stemmed plants of *Drosera huegelii* from the highest peaks of the Stirling Range in south western Australia have been found to differ in a number of aspects from the more widespread typical form of this taxon and are recognized as a distinct variety.

Introduction

The short-stemmed form of *Drosera huegelii* Endl. from the highest peaks of the Stirling Range, in south western Australia has been known for many decades (e.g. Gibson 2001). It grows in montane shrubland above 800 meters elevation in an environment that experiences light snowfalls during most winters. It has often informally been referred to as the ‘Dwarf Form’ (Barrett 2000) and for much of this time it has been recognized that this entity required further study to see whether it warrants recognition as a distinct taxon.

At least two other examples of pairs of morphologically similar taxa, that differ primarily in stature, occurs within the tuberous *Drosera* flora of south western Australia. *Drosera moorei* (Diels) Lowrie is a climbing or scrambling sundew which grows on the aprons of granite outcrops. *Drosera zigzagia* Lowrie, in contrast, is a short, erect taxon in the same region which grows on the margins of salt lakes (Lowrie 1999). Both are native to the eastern wheatbelt and southern goldfields regions (Lowrie 1987). These taxa share yellow petalled flowers, glabrous sepals and stems, but differ in stature, habit, leaf number per node, leaf shape, sepal shape, and flower part and seed size and were thus considered to be different species (Lowrie 1999). Similarly, *Drosera monticola* (Lowrie & Marchant) Lowrie and *D. purpurascens* Schlotth. are two tuberous fan-leaved sundews (*Drosera* subg. *Ergaleium* section *Stolonifera*). *Drosera monticola* is endemic to the highest peaks of the Stirling Range and is smaller in all parts than *D. purpurascens* which grows widely across the south west but at lower elevations. These two taxa also differ by way of the presence of secondary stolons, the presence or absence of horizontal stolon section between the point of emergence and base of leafy rosette, and petal color. They were treated as separate species (Lowrie 2005, 2011).

Drosera huegelii is known to develop a variable number of leaves (Erickson 1978). Some of this is due to predation (Lowrie 2014) but at other times it appears to be due to seasonal ambient conditions. This variation was taken into account when studying plants for this project, particularly where short-stemmed plants had also been collected from few low-elevation sites, such as Mount Lindesay, near Denmark, and Ficifolia Road, near Walpole.

Materials and Methods

Herbarium collections and wild populations of *D. huegelii* were studied from across its range, with particular attention to short-stemmed specimens. Cultivated plants were also examined.

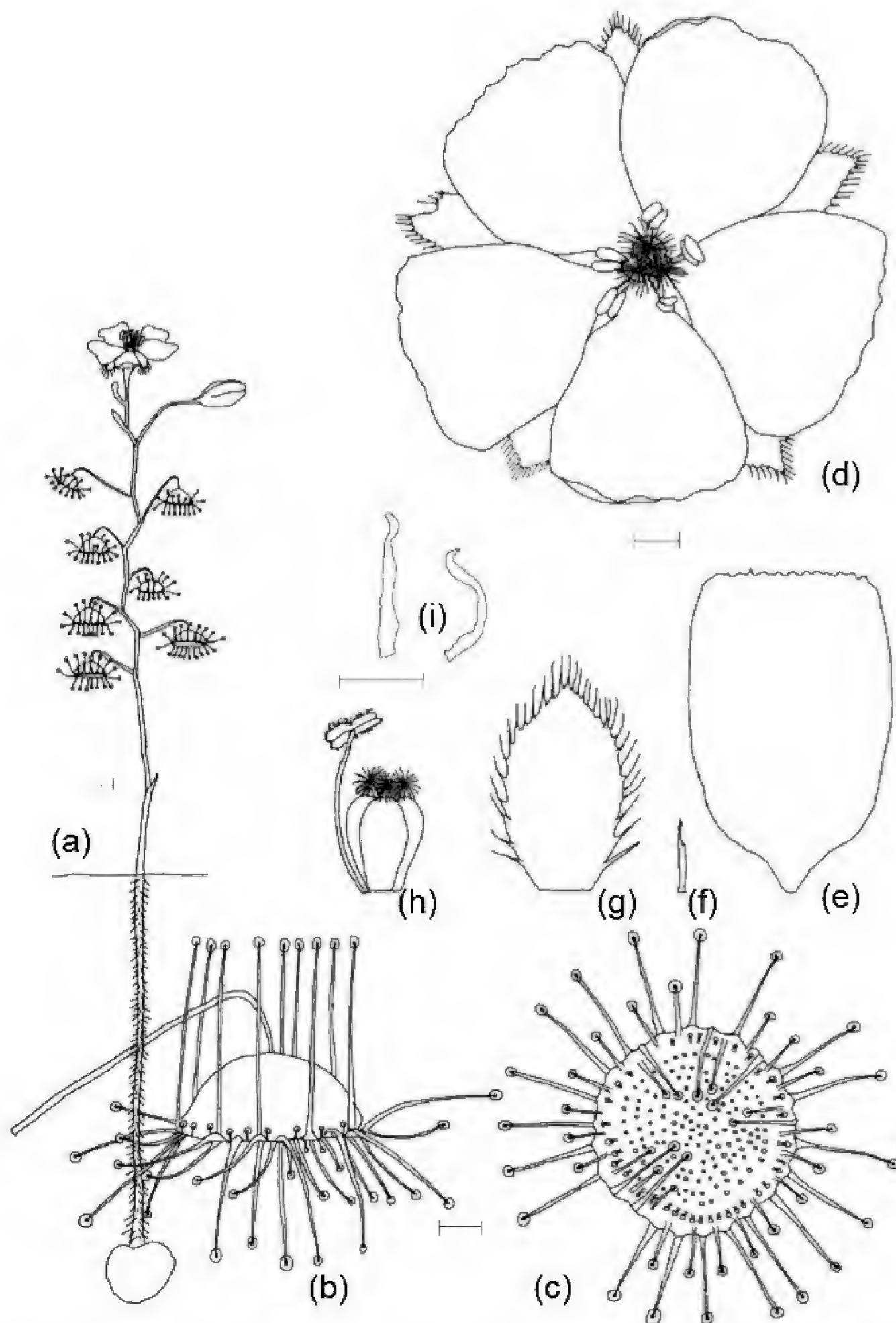


Figure 1: Botanic illustration of *Drosera huegelii* var. *phillmanniana* (a) plant, (b) lamina from side, (c) lamina from below, (d) open flower, (e) petal, (f) bracteole, (g) sepal, (h) ovary, styles and one stamen, and (i) seeds. Scale bar = 1 mm in all cases. Three levels of magnification are used for items (a); (b), and (c); and (d) to (i) inclusive. Sketch by R. Gibson.

Description

Drosera huegelii Endl. var. *phillmanniana* Y.-A.Utz & R.P.Gibson var. nov.

Diagnosis: Similar to *D. huegelii* var. *huegelii* but differs in having a consistently shorter stem in flowering plants of up to 12 cm tall.

Type: Australia. Western Australia: S. Barrett 633 (PERTH 4273567), 7 September 1995. Summit of Bluff Knoll, SE aspect.

Description: A green to light red-bronze colored tuberous perennial herb, plant with a single weakly flexuous, erect, self-supporting stem of flowering specimens to 12 cm tall (Fig. 1). **Stem** glabrous, lower part bearing 1-5 subulate prophylls 1-3 mm long, the remainder bearing usually 7-9 solitary, alternate cauline leaves; the axil of the uppermost leaf may occasionally produce a smaller secondary leaf. **Tuber** white, smooth, \pm globose, 8-10 mm diameter, enclosed in a black papery sheath; at the end of a vertical stolon 3-6 cm long. **Leaves** down-facing, borne on a semi-erect but hooked pedicel 10-14 mm long which is glabrous. Lamina very broadly campaniform, 5-6 mm diameter; very deeply cupped, 2-3 mm deep, pendulous with an orbicular opening. Abaxial surface glabrous. **Inflorescence** of a solitary flower or paniculate, terminal, 1-3-flowered. Peduncles to 6 mm long, glabrous; pedicels 6-25 mm long, glabrous. **Bracts**, linear to spatulate, 2-4 mm long. **Sepals** 5, green to red, ovate, elliptic to obovate, 5-6 mm long, 3-4 mm wide; margins laciniate; abaxial surface glabrous. **Petals** 5, creamy white, obovate to oblong, margins entire, apex truncate and denticulate, 8 mm long, 5-6 mm wide. **Stamens** 5, filaments white, to 2 mm long; anthers to 1 mm long, pale orange; pollen yellow. **Ovary** reddish brown, obconic, 1.2 mm long, 1 mm diameter; carpels 3. **Styles** 3, white, to 1 mm long, greatly divided into many filiform segments forming a tuft about 2 mm diameter at the apex of the ovary. **Seeds** dull black, straight or folded, linear to narrowly ovate, striated, flattened, to 1.8 mm long by 0.2 mm wide with funicle and apex weakly inflated (Fig. 2).

Immature plants of *D. huegelii* var. *phillmanniana* form flat rosettes of transversely elliptic lamina borne on linear petioles.

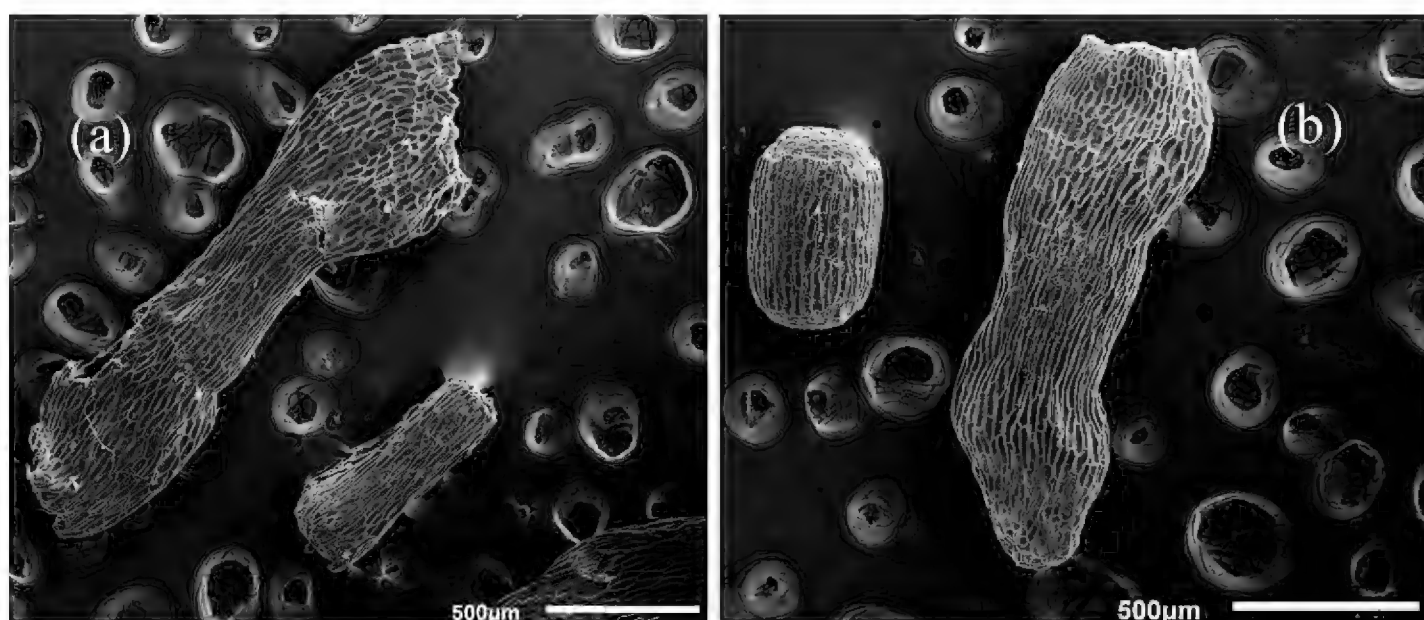


Figure 2: SEM images of the seeds of (a) *D. huegelii* var. *huegelii*, and (b), *D. huegelii* var. *phillmanniana*. The images include an example of a seed with and without the funicle and apex.

Table 1. Summary of differences between these two taxa.		
Character of mature plants	<i>Drosera huegelii</i> var. <i>phillmanniana</i>	<i>Drosera huegelii</i> var. <i>huegelii</i>
Plant maximum height (cm)	12	50
Tuber diameter (mm)	8-10	10-15
Lamina length (mm)	2-3	4-6
Cauline lamina cross-section	Broadly U-shaped	Narrowly U-shaped
No. of flowers per panicle	1-3	3-20
Peduncle length (mm)	6	20-35
Pedicel length (mm)	10-14	15-45
Ovary color	Red-brown	Green

Key differences between both varieties of *Drosera huegelii* are presented in Table 1 and are shown in Fig. 3.

Selected specimens examined:

D. huegelii var. *phillmanniana*

Capt. A. Dorrien Smith, 1910. Warrunup Hill, Stirling Range. Herbarium Kewense, WA, 1909-1910. (Det. Note by R. Erickson, 1963); S. Barrett 527 [PERTH 4135946], 21 Sept. 1995, Ellen Peak, Stirling Range; S.Barrett 330.8 [PERTH 4311566], 10 Oct. 1994, Hume Peak, Stirling Range; W. Bopp 120 [PERTH 4284976], 25 September 1994, western base of Bluff Knoll, Stirling Range.

D. huegelii var. *huegelii*

S.C. Coffey 116 A [PERTH 8468133], 13 Sept. 2009, Cape Arid National Park, near pay station; P.A. Jurjevich 1812 [PERTH 4822854], 8 Sept. 1997, 10 km W of Donnybrook; P.Mann 44/2003 & R.P. Gibson [NSW 884459]. 25 Oct. 2003, 10 km NWN of Cranbrook; R.P. Gibson 271 & P. Mann [NSW 897543], 14 Sept. 2010. About 3 km E of Boyanup.

Etymology: This taxon is named in honor of our late friend, Phillip (Phill) Mann (1951 - 2014), who independently recognized the consistently diminutive habit of this taxon on the highest peaks of the Stirling Range. He encouraged both of us to take a closer look at these plants.

Phenology: Plants have been collected in flower in September (Southern Hemisphere) or January (Northern Hemisphere). Flowers open when the ambient air temperature exceeds about 15°C.

Distribution and ecology: *Drosera huegelii* var. *phillmanniana* has been recorded or observed on peaks of the Stirling Range that are above 800 meters elevation (Fig. 4). On Bluff Knoll it occurs in Eastern Stirling Range Montane Heath and Thicket Community (Barrett 2000) where it grows in open areas between shrubs; often in the company of *Drosera monticola*.

Robust, multi-flowered plants of *D. huegelii* var. *huegelii* grow beside the path to the summit plateau of Bluff Knoll [e.g. Bopp 120 [PERTH 428976] in sheltered forest. However, they do not grow with *D. huegelii* var. *phillmanniana* plants on the summit plateau – about 500 meters to the



Figure 3: Comparison of *Drosera huegelii* var. *phillmanniana* and *D. huegelii* var. *huegelii*. *D. huegelii* var. *huegelii*: (a) mature plants in bud; (b) open flower; and (c) ripe seeds on a 2 mm grid. *Drosera huegelii* var. *phillmanniana*: (d) of plants in bud in cultivation, (e) open flowers; (f) ripe seeds; (g) plant in bud in the wild; (h) habitat in low open shrubland on the summit plateau of Bluff Knoll; and (i) comparison of mature plant tubers: *D. h.* v. *huegelii* (left) and *D. h.* v. *phillmanniana* (right) on a 2 mm grid. Photos (g) and (h) by R.G., all others by Y-A.U.

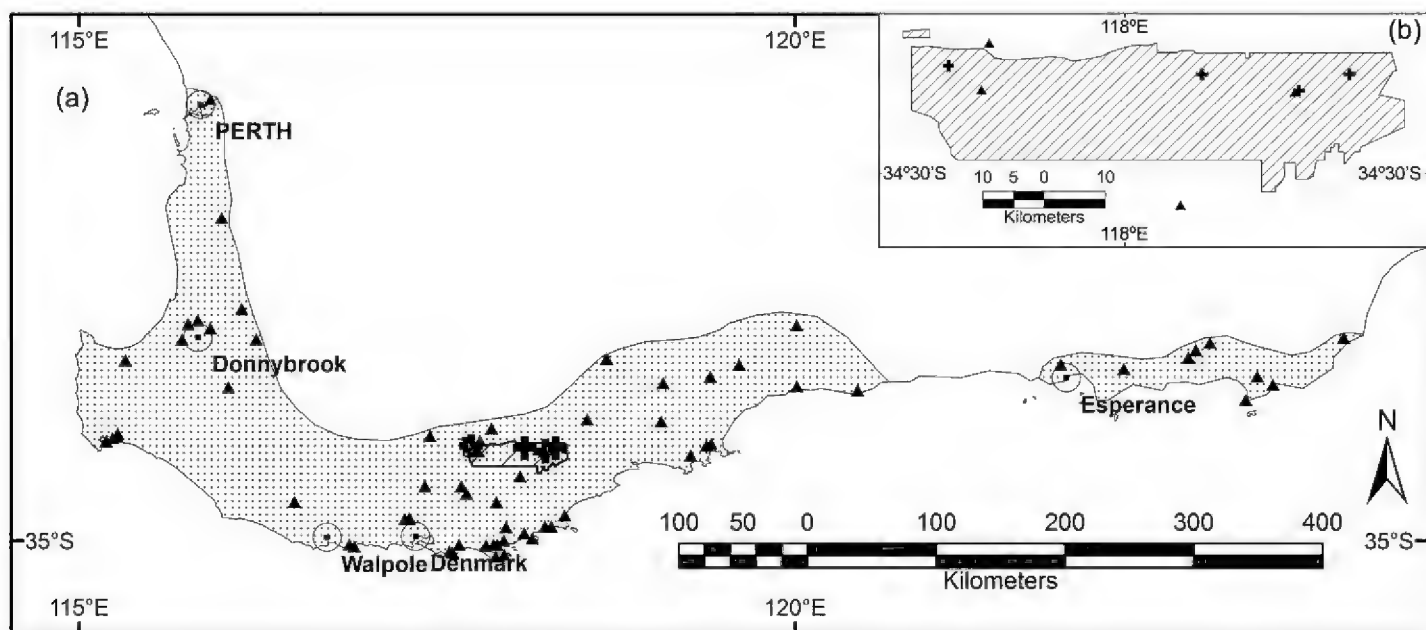


Figure 4: (a) Approximate distribution of *Drosera huegelii* is shown by stippling. Records of *D. huegelii* var. *huegelii* (▲) occur widely, however those of *D. huegelii* var. *phillmanniana* (+) have only been recorded within the Stirling National Park (diagonal lined polygon – see inset map (b)).

east and about 300 meters higher up. Plants of both varieties have been in cultivation for many years and retain their differing stature when grown under the same conditions.

Collections of short-stemmed plants around 10 cm maximum height have been made in a few coastal locations: notably Mount Lindesay, 14 km N of Denmark (S. Barrett 622 [PERTH 4273575]); beside Ficifolia Road, about 15 km E of Walpole (J. Wheeler 3120 [PERTH 5052785]); and 10 km W of Donnybrook (P.A. Jurjevich 1812 [PERTH 4822854]). Examination of these specimens has revealed that they had deeply cupped lamina and so represented short individuals of the typical form.

Conservation Status: This taxon appears to warrant ‘Endangered’ species status. It has a very limited range in which it typically occurs in a low density; at most a few thousand plants may occur in the wild. Further, its key habitat, ‘Eastern Stirling Range Montane Heath and Thicket Community’, is a Nationally-listed Critically Endangered Ecological Community (Barrett 2000). The main threat to this vegetation community is the impact of Dieback Fungus *Phytophthora cinnamomi*. This sundew does not appear to be killed by this pathogen, however it could pose an indirect threat by killing associated plant taxa and thereby modifying vegetation structure of its habitat.

Notes: *Drosera huegelii* var. *phillmanniana* shares most morphological characters with *D. huegelii* subsp. *huegelii*. From preliminary molecular studies and controlled pollinations between both taxa resulting in seed set, they appear to also be very closely related. Therefore, unlike the case of say, *D. zigzagia*, this taxon is not considered different enough to warrant neither specific nor subspecific rank.

Updated dichotomous key (Modified from Marchant *et al.* 1982)

- 10: Leaf lamina distinctly conical, inverted
- 11: Stems > 12 cm tall with >5 flowers per inflorescence *D. huegelii* var. *huegelii*
- 11: Stems < 12 cm tall with <5 flowers per inflorescence *D. huegelii* var. *phillmanniana*

Acknowledgements: We thank Dr. Neville Marchant for examining voucher specimens at PERTH and checking the stature of putative plants of this taxon at selected populations in south western Australia. We also thank Sylvain Loubéry and Anne Utz-Pugin, at Unité d’Imagerie des Plantes, Université de Genève, for the SEM images. RG thanks the Director and staff for study access and assistance at the herbaria at Kew, British Museum, and Perth. We both thank Phill’s family who provided generous logistical support and friendship during field visits to Western Australia on which we could see this taxon in the wild.

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DROSERA HYBRIDA, THE NEXT GENERATION

JOHN BRITTNACHER • Ashland • Oregon • USA • john@carnivorousplants.org

Keywords: hybrids, *Drosera hybrida*.

Plants are generally known for being promiscuous and *Drosera* is no exception. Many *Drosera* hybrids occur in nature and many more can be made artificially (see Ziemer 2017 and Brittnacher 2010 for examples). Natural hybrids between species that are very closely related and have fertile offspring can be a pain for hobbyists, botanists, and taxonomists because the plants pass characters back and forth and it is hard to know exactly what you are studying or growing. Natural hybrids between species with sterile offspring are more easily studied and are interesting because if the sterility is due to chromosomal pairing issues, the sterility can be resolved via polyploidy. The resulting fertile allopolyploid plants are essentially instant species in the evolutionary sense. Allopolyploid speciation is the most common form of hybrid speciation (Mallet 2007; Soltis *et al.* 2003) and changes in ploidy may represent about 2% to 4% of speciation events in flowering plants (Otto & Whitton 2000). In carnivorous plants, the best examples of hybrid speciation via allopolyploidy are *D. anglica* (Wood 1955) and *D. tokaiensis* (Shirakawa *et al.* 2012). In the case of *D. tokaiensis* in Japan, *D. spatulata* and *D. rotundifolia* crossed and produced sterile offspring. When chromosome doubling events occurred, either sexually or somatically, fertile *D. tokaiensis* resulted. Polyploidization set the population of *D. tokaiensis* on an evolutionary trajectory where at some point the plants in the wild will no longer be the same as the original hybrid. Over time, polyploids tend to become essentially diploids and excess genomic material is trimmed out or repurposed. In order to determine how much *D. tokaiensis* has evolved so far, Tungkajiwangkoon *et al.* (2016) compared the genome sizes of wild plants with the genome sizes of artificially produced *D. tokaiensis* and the parents. The genome size of the wild *D. tokaiensis* was found to be 15% less than expected. This indicates that *D. tokaiensis* is measurably into the polyploidization/diploidization/genome trimming cycle that has been a major factor in plant evolution (Marchant *et al.* 2016).

Drosera hybrida is an example of a potential instant species in that it immediately becomes a new independent evolutionary unit when a fertile population arises in the wild from its sterile, hybrid progenitors. The parents of the hybrid are the unlikely pair *D. filiformis* and *D. intermedia*. Sterile natural hybrids have been found and are known in New Jersey but no fertile plants have been found there yet (Ksepka 2017). Fertile hybrids were found in California where the plants were planted out in a protected botanical area (D'Amato 2013), so it is quite possible that someday fertile plants will also be found in its native range. When this happens, it is up to taxonomists to decide how to refer to the different plants. In this paper, I use "*Drosera hybrida*" primarily to refer to the fertile plant (the next generation) but cannot avoid using that name for the sterile hybrid as well. Article H3 of the ICN (McNeill *et al.* 2012) allows for not using the "×" in front of the epithet of a hybrid species.

Drosera filiformis and *D. intermedia* are unlikely parents of a hybrid because the plants are so reproductively different. The fact that one is a tall thread-leaved plant and the other a small, ground hugging, spoon-leaved plant is not important. It is the flowers that matter. *D. filiformis* has pink flowers about 20 mm across borne at least 200 mm above the ground. *D. intermedia* has white flowers about 9 mm across about 70 mm above the ground. *D. filiformis* blooms during the late spring and early summer before *D. intermedia* or overlapping a week or two depending on the location and

weather. Even when they bloom at the same time, individual *D. filiformis* flowers start opening at sunrise and close at noon. *D. intermedia* flowers open two or three hours after sunrise and close one or two hours after noon. With all these differences, it would be unlikely for them to share pollinators. Figure 1A shows a sweat bee (family Halictidae) pollinating a *D. filiformis* flower. The bee walked in a circle around the whorl of stamens, harvesting pollen from the anthers. The outer side of the bee and its leg pollen basket touched the stigmas as it moved past them leaving pollen. The styles appear to lie near or against the petals to not be in the way of the bee and the distance of the stigmas to the anthers was just right for the bee to pollinate the flower with pollen from a different flower. *D. intermedia* is probably also pollinated by sweat bees although they need to be smaller and be active later in the season than the bees that pollinate *D. filiformis*. These bees crawl over the stigmas to get to the anthers to collect pollen. Tiny sweat bees could easily visit late season *D. filiformis* flowers to harvest pollen and then if they did not get enough pollen, visit a *D. intermedia* flower harvesting the *D. intermedia* pollen but leaving some *D. filiformis* pollen on the stigmas. I am sure other insects visit the flowers and other scenarios are possible.

The observation by Jim Bockowski at Martha Furnace, New Jersey, of multiple clumps of hybrid *D. hybrida* plants growing out of old seed capsules on a fallen *D. filiformis* scape (Brittnacher 2011) has bothered me for a long time. We are talking about a rare event happening in multiple flowers on the same scape or a very rare case of a sterile *D. hybrida* having false vivipary at multiple nodes along a scape. After the paper was published, I noticed one of my *D. filiformis* plants failed to produce seeds one year. Normally *D. filiformis* flowers self-pollinate as the petals close. My first thought was a male sterile. That would be perfect. I had tried pollinating flowers to make hybrids without removing the anthers. I got no hybrids. That indicated to me that own-species pollen will outcompete other-species pollen if both kinds of pollen are present on the stigmas. A male sterile plant would always have to outcross. But it turned out my plant without seeds produces longer than typical styles and shorter stamens under certain conditions—I think cold weather but have not done a proper study. The styles can be so long relative to the stamens that the flowers do not self-pollinate when they close (Fig. 1B,C). Typically, *D. tracyi* flowers have a low rate of self-pollination for the same reason. An unusual *D. filiformis* plant with extra-long styles blooming late near a clump of *D. intermedia* could account for Jim's observation.

The next major stumbling block in generating a fertile *D. hybrida* is doubling of chromosomes. This can happen via meiotic chromosome non-disjunction during pollen and ovule production assuming there are no other pollen and ovule development, post fertilization, or genomic interaction issues in the otherwise sterile hybrid (Martienssen 2010). A second way to double the chromosomes is mitotic chromosome non-disjunction in a stem cell producing a chimeric plant that is part diploid and part tetraploid. There are no reports of this happening in New Jersey but it did occur in California.

Between 1985 and 1990, two carnivore fanatics planted out many *D. hybrida* plants they reproduced from leaf cuttings in the Butterfly Valley Botanical Area near Quincy, California (Brittnacher 2012a). Their purpose was to set up a sanctuary for the hybrid because they had difficulty keeping the plant alive in the central valley of California. After a few failures, the plants became established and did exceedingly well (Anon. pers. comm. 2011). In 2006, Harry Tryon (pers. comm. 2012) found the plants while visiting the site. He grew *D. hybrida* at home but did not recognize these plants as being the same. I had visited the site with Barry Rice two years earlier, in 2004, at the request of the USDA Forest Service botanist in charge of the Botanical Area. The botanist was regularly having to remove exotic plants from the Botanical Area but was not sure what a particular sundew was. We were not sure what it was either. The scapes looked like *D. filiformis*; the leaves

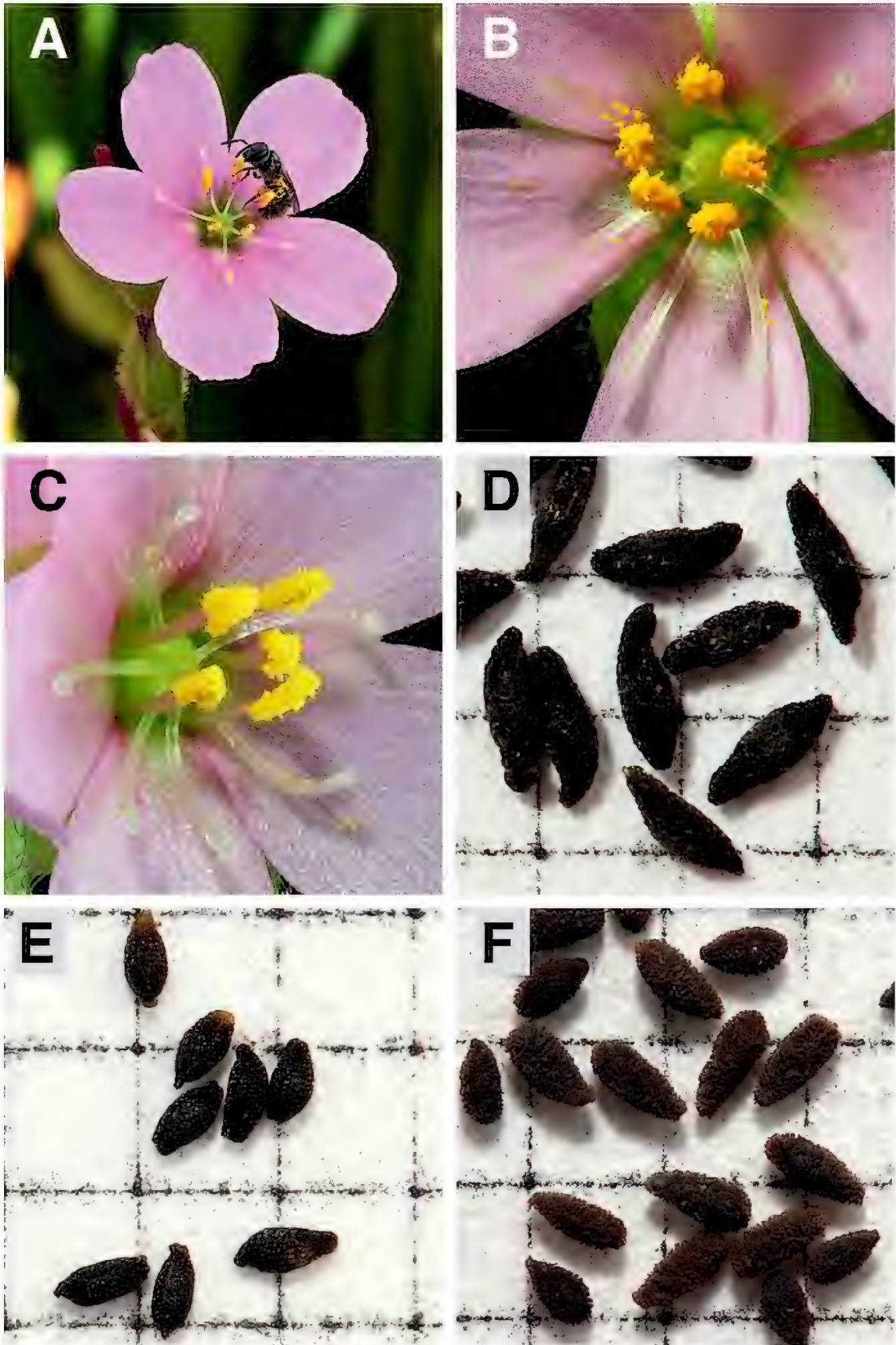


Figure 1: (A) Sweat bee (family Halictidae) harvesting pollen on a *Drosera filiformis* flower. (B) Detail of a *D. filiformis* flower with long styles and short stamens. (C) A more typical *D. filiformis* flower as it starts to close. (D) *D. hybrida* seeds on a 1 mm grid. (E) *D. filiformis*, New Jersey, seeds. (F) *D. intermedia*, New Jersey, seeds.



Figure 2: *Drosera hybrida* plants at the Butterfly Valley Botanical Area, near Quincy, California, in 2004. The plants have since been removed.

definitely were not (Fig. 2). We grew *D. hybrida* at the UC Davis Botanical Conservatory but they were nasty little things in comparison. We did not find seeds in the capsules so knew it must be a hybrid, but what? We brought back a few plants to Davis and were able to confirm they were *D. hybrida*. Starting in 2007, Barry assisted the Forest Service in removing all the *D. hybrida* from the Botanical Area. Barry sent me some of the plants that were removed. Although we did not find seeds in 2004, Harry did find seeds in 2006, the year before the plants were removed. He planted the seeds at his home. Harry gave me divisions from his plants in 2011. He also distributed fertile plants at the July 2011 California Carnivores open house. After getting the fertile plants from Harry, I decided

to characterize how the fertile plants were different under common growing conditions from all the various clones I had acquired.

In general, the fertile *D. hybrida* are nothing to get excited about for a general hobbyist (Fig. 3c). There are nicer clones that are more vigorous and bloom more often. They just don't produce seeds. Whatever happened to "hybrid vigor"? Polyploidy introduces a physiological load on a plant. Many genes are closely regulated to produce only so much product. There are now twice as many of those genes and they are producing twice what the plant needs. In a normal plant that is not as big a deal as it is for a nutrient-limited carnivore. That is why some of the smallest genomes are in carnivorous plants. With *D. hybrida* we are talking about plants that have not had the time for diploidization or "normalization" of gene expression to occur. What is bigger in the fertile plants? The seeds are larger than either of the parents' seeds (Fig. 1D-F) and the leaves tend to be a little wider although they may be shorter. The flowers of the fertile tetraploid plants are identical to sterile plants. Both kinds of plants can have stamens too short or styles too long to self-pollinate when the flower closes (Fig. 3a,b). This has led some people to question the fertility of the tetraploid (D'Amato 2015). The tetraploid cannot produce seeds if pollination fails for mechanical reasons.

One significant difference between the fertile plants and sterile plants is that the fertile plants do not bloom as often. In 2017, only 16% of my fertile plants bloomed compared to 61% of my New Jersey-sourced plants (Table 1). This is not totally surprising. I have over 30 tetraploid *D. eloisiana* plants and 6 *D.* 'Nightmare' plants. None of them bloomed in the past two seasons! But what was surprising to me was that I have had four fertile plants "appear" in pots with the Butterfly Valley Botanical Area plants sent to me in 2007. Yes, there could have been a re-potting error. Yes, I could have made a mistake while taking leaf cuttings. But given that the tetraploids bloom about once every 6 years, there could have been a tetraploid plant among the ones I received direct from the Botanical Area and it just didn't become obvious until years later when it and its leaf cutting offspring first bloomed for me.

In the Butterfly Valley Botanical Area plant-out drama, none of the leading and supporting actors recall the exact source of the Botanical Area *D. hybrida* plants. There were at least two New Jersey sources of different clones at that time (Brittnacher 2011; Ksepka 2017). It is apparent from the vigor of the plants and number of flowers per scape grown under my conditions, there is a difference between the plants I sourced from California and those I sourced from New Jersey. It is not as if the California plants cannot look like the New Jersey plants under the right conditions. The plants at the Botanical Area in Figure 2 have the same number of flowers per scape as the Burlington Co., New Jersey, plants in the wild (Ksepka 2017). In any case, the California-sourced plants were a clone that was not as vigorous as others available now.

Is there anything special about the Butterfly Valley Botanical Area that could have contributed to the polyploidization event? I very much doubt the Botanical Area contains a cosmic vortex but there are botanists who might disagree. The Botanical Area has a tremendous variety of rare plants (Cheatham 1976). This is most likely the result of the site being wetter at a lower elevation than is likely in the Sierra Nevada. Peter D'Amato (2015) suggested that a late frost while flowering could have caused plants to produce polyploid seeds. There is some basis to make this suggestion because polyploids are more common at higher latitudes and elevations. However, most research on polyploids more or less assumes polyploids will happen. Polyploidy itself is more likely to be advantageous and thus to persist in cold environments (Soltis *et al.* 2003; Brochmann *et al.* 2004). Also, the Botanical Area is only at 1150 m elevation. Barry Rice (pers. comm.) has been to a large population of the hybrid between *D. anglica* and *D. rotundifolia* in the Oregon Cascades at a similar elevation and not found any fertile *D. obovata* plants. The large population at that location can be

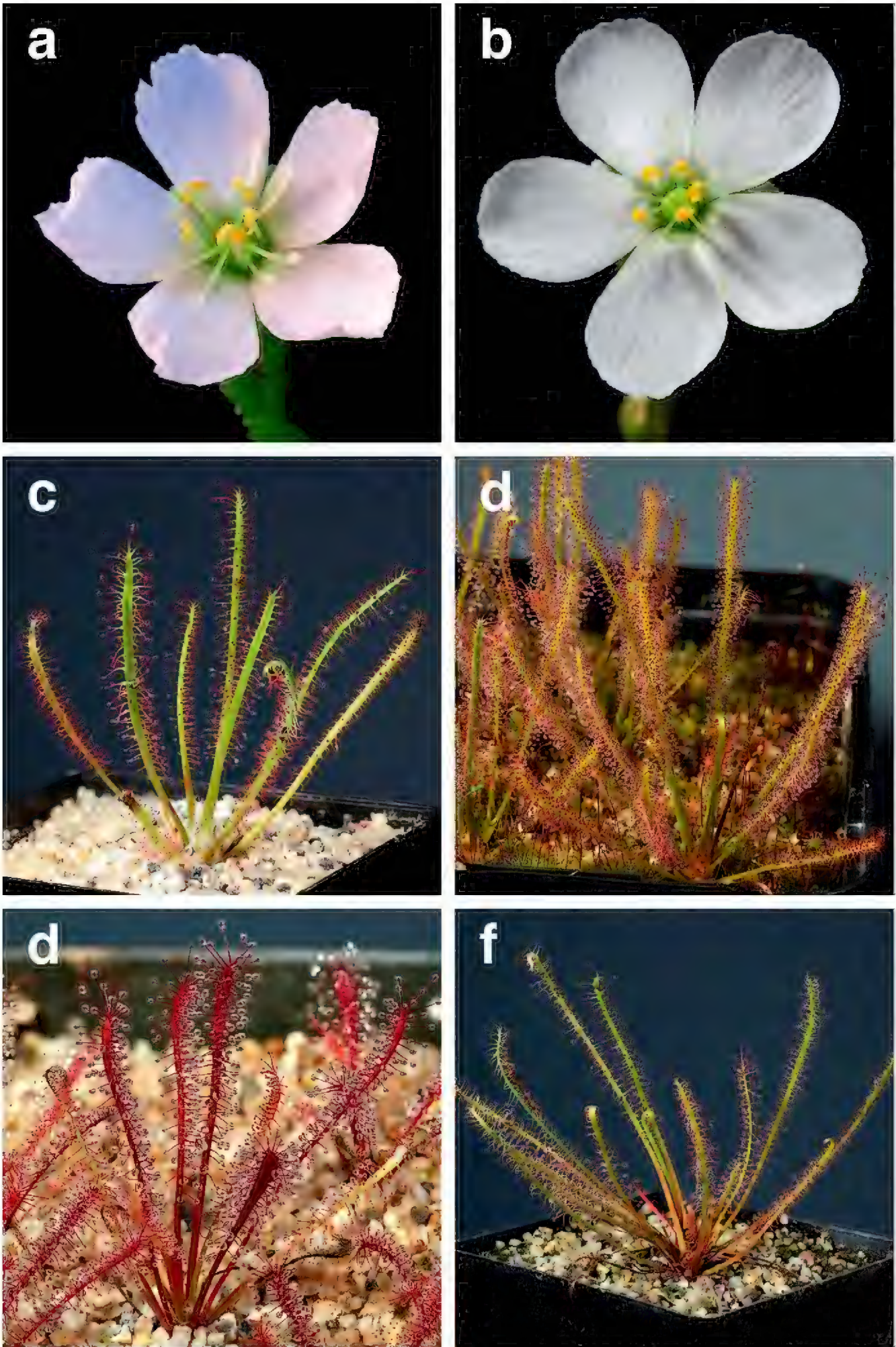


Figure 3: (a) *Drosera hybrida*, HT06 tetraploid flower. (b) *D. intermedia* × 'California Sunset' flower. (c) *D. hybrida*, HT06 tetraploid plant. (d) *D. filiformis* × *intermedia*, new hybrid. (e) *D. filiformis* var. *floridana* × *intermedia* plant. (f.) *D. intermedia* × 'California Sunset' plant.

Table 1. Scape per plant and flower number per scape for *D. hybrida* grown under identical conditions during 2017 in Ashland, Oregon.

Clone ¹	Number of Plants	Scapes per Plant	Flowers per Scape
Tetraploid ²			
HT06	47	0.17	3.25
BV07PS	22	0.09	3.00
California ^{2,3}			
BV07	23	0.35	3.88
BV04	17	0.59	4.80 ⁴
HTCC	16	0.69	3.36
New Jersey ^{2,3}			
LakeA	27	0.63	6.24
Burlington	29	0.59	6.00 ⁴

¹Personal clone names: HT06 are initially from Harry Tryon from seed collected at Butterfly Valley Botanical Area, California, in 2006, propagated by division, leaf cuttings, and seeds; BV07PS are BV07 plants that produced seeds or were accidentally mixed up from HT06, propagated by leaf cuttings and seeds; BV07 are plants directly from the 2007 Butterfly Valley Botanical Area eradication, propagated by leaf cuttings; BV04 are plants propagated from the 2004 Butterfly Valley Botanical Area sampling maintained at UC Davis; HTCC are from Harry Tryon that he got from California Carnivores; LakeA are from plants collected at Lake Absegami, New Jersey, by Rich Sivertsen (see Brittnacher 2011); Burlington are propagated by leaf cuttings from plants collected with permission in Burlington Co., New Jersey (Ksepka 2017).

²The tetraploid plants had significantly fewer scapes per plant than the non-tetraploid plants (Chi-squared test, $p<0.01$).

³The California-sourced plants had significantly fewer flowers per scape than the New Jersey-sourced plants (Chi-squared test, $p<0.01$).

⁴Photos of plants at the Butterfly Valley Botanical Area, California, (Fig. 2) show most scapes on the plants having about 10 to 12 flowers per scape, similar to plants in Burlington Co., New Jersey (Ksepka 2017 (Fig. 1 p. 149 this issue)).

explained by animal disturbance and false vivipary so it is not as if the presence of so many plants indicates there should be fertile individuals. In another example, the tetraploid *D. anglica* is a cool to cold climate-associated plant. If it didn’t exist before the last ice age, it could have arisen near the USA/Canada border mid-continent where one of its parents, *D. linearis*, is found today. If the species is older, which I think it is because of its extensive range, all bets are off about its history.

Why is *D. hybrida* only found in New Jersey while the parents coexist in other locations as well? It could be an issue in which the flowering times of *D. filiformis* and *D. intermedia* do not overlap, or do not overlap very often. Or it could be the available pollinators are not interested or do not exhibit the right behaviors. But that does not mean we cannot make our own if we can “encourage” our plants to bloom at the same time. Figure 3d shows one of a number of new hybrids I have made between *D. filiformis* and *D. intermedia*. They are easy to make IF you can get the parents to bloom at the same time and you can make the crosses between 10 and 11 a.m. and the flowers have not been visited by a pollinator when you get around to it and you are careful to remove the anthers without accidentally getting pollen on the stigmas and in the case of *D. intermedia* you remove the anthers

without also removing the styles. For me, some years there is more bloom overlap than others. Figure 3e shows *D. filiformis* var. *floridana* × *intermedia* using a typical, minimal dormancy clone of *D. filiformis* var. *floridana*. The plants produced so far are rather small and not very vigorous. The *D. intermedia* × ‘California Sunset’ (Fig. 3b,f) are more encouraging.

The polyploid nature of *D. hybrida*, *D. anglica*, and *D. tokaiensis* is not a mere curiosity. The scientific study of relatively recent polyploids gives us insights into the evolution of *Drosera* species in general. The progenitors of all carnivorous plant species have been through the genome polyploidization/diploidization/genome trimming cycle many times (Marchant *et al.* 2016). These cycles have helped provide the genetic tools for the plants to build unique structures and to adapt to extreme environments. Within the genus *Drosera* there are numerous examples of ancient polyploidy. Most *Drosera* species in Africa and many in South America are diploidized tetraploids as are *D. neocaledonica*, *D. ultramafica*, *D. oblanceolata*, and many *D. spatulata* populations in Australia, Oceania and Asia (see Brittnacher 2012b for more examples). The progenitors of these species at some point in the distant past probably were in the same tenuous situation as *D. hybrida* is today.

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I'M NOT DEAD YET, RE-FINDING *DROSERA* × *HYBRIDA* IN THE WILD

JASON KSEPKA • Farmingdale • New Jersey • USA • jasonksepka@gmail.com

Keywords: *Drosera* × *hybrida*, pinelands, Pine Barrens, hybrid, disturbance.

In his 2011 CPN article “*Drosera* × *hybrida* rest in peace”, John Brittnacher (2011) declared *D. × hybrida* extinct in the wild. Indeed, the cover photo was one that I took, which, as it turned out later, would be the last known photo of that hybrid in the wild at that time. I am writing this article as an update to John’s 2011 article by adding six new locations of *D. × hybrida* in two counties of southern New Jersey.

The first time I saw *D. × hybrida* was on a Mother’s Day trip in 2008 with Rich Sivertsen, Fernando Rivadavia, Matt Hockburg, and Dave Evans. It was at the original site in Bass River State Park where Rich discovered the second known occurrence of this plant in 1974, and the only one that survived, identifiable, in cultivation. The Bass River SP clone is the only plant that has been in cultivation from a wild source. Any other plants are either missing their source of origin, or were created by hobbyists in cultivation. The single plant that remained was just waking from winter dormancy. Small and insignificant as this plant was, ironically for a sterile hybrid, it planted a seed in my brain.

I had since my teen years become a very close friend to Jim Bockowski. We talked about this plant and his finding of the third known locality on the Oswego River in 1978. He gave me directions to the site. I visited it many times, carefully inspecting every *Drosera* I could find up and down the banks of the river. I was not able to relocate the *D. × hybrida* plant, despite the presence of large numbers of both parent species. Over the years Jim and I spoke often about the idea that disturbance seems to be the key to breaking the reproductive barrier that naturally kept these species from hybridizing. It seems that there was a natural or manmade disturbance at each of the original three sites. This may have broken down barriers such as timing of flowering, by delaying a damaged *D. filiformis* flowering, increasing the slight overlap in time that it flowers with that of *D. intermedia*. Spatial barriers may be broken as well, if the flower scape of the *D. filiformis* is knocked down by the disturbance and is physically closer to the *D. intermedia* flower. A pollinator would be needed, and if the flowers were closer, it is simply more likely that a pollinator might take advantage of that proximity, and visit both flowers consecutively, even if there is a normal preference for one species over the other. Additionally, further disturbances could damage the already created hybrid and either destroy them, or break them up which would increase the numbers vegetatively (Brittnacher, pers. comm. 2017). With our conversations, I began targeting sites where I knew both parent species to occur with disturbance. For these purposes, there is fortunately or unfortunately a very high degree of disturbance to almost all areas within the Pinelands of New Jersey.

The first re-finding of *Drosera* × *hybrida* after John’s 2011 paper happened in a totally unexpected way. On a rainy day, I was at a nursery where I had become acquainted with the staff. A customer came in, fascinated by the work I was doing with *Drosera* × *eloisiana* (the hybrid *D. rotundifolia* × *D. intermedia*). He mentioned a site with hybrid *Drosera* on it. I looked at him and said that *Drosera* × *eloisiana* are quite common. He explained that he thinks it is a different one. I jumped up and he offered to show me. We drove an hour away and got out in the pouring rain. We walked a trail and came to a site that had many large clumps, and many individual plants of *Drosera* × *hybrida* (Fig. 1)!!! I was ecstatic. It was June 12, 2012, only 7 months after John’s article. I immediately noticed that the site was actually a truck trail driven by vehicles to access parts of the forest. This site



Figure 1: *Drosera* \times *hybrida* site showing the disturbance by vehicles (left). One of the many beautiful *D. x hybrida* plants found at this site (right). Note the false vivipary (arrow). This is one likely way that this hybrid is propagated (Brittnacher 2017).

happened to be wet enough for *Drosera* to grow. I quickly connected the dots and could see the role the vehicles played in the disturbance needed to break those reproductive barriers. I could easily see how the production of even one sterile hybrid could have made so many plants due to the breaking up of the leaves and clumps by the tires and water. It did however tickle my brain a bit thinking that perhaps it had gone tetraploid and was now fertile and reproductive. Later searches of the site found no evidence of this, though I am still checking periodically.

While there, I asked the gentleman who showed me the site if I could collect several pieces of these plants to bring into cultivation. With permission, I collected 15 pieces of 15 different clumps and leaf cuttings from smaller plants as well. These still remain with me as I continue to propagate them. The purpose of getting them into culture so quickly was to protect the plants if something should happen to the site. I am glad that we did this. On August 11, 2012, I had the pleasure of picking Fernando Rivadavia up at the airport when he flew in to the area for the ICPS conference in Massachusetts. I toured him around the pinelands a bit before we headed up to the conference. When we got to the *D. x hybrida* site, I was horrified to see that it had been mowed. Not so much because the plants couldn't take it, but because the shrubs that had protected the site from the adjacent sandy upland, were destroyed. The plants were mowed down, and I was not able to check that year for viable seed, but I feared worse things were on their way. Within 2 weeks, that area had been hit by a massive downpour of 20 cm of rain in 12 hours. I returned to investigate and the site had been nearly covered by sand and debris from the upland.



Figure 2: The main clump of *D. x hybrida* is to the right of center. Notice the slumping of the bank, with smaller divisions or leaf cuttings growing below the mother plant and closer to the water's edge.

I frantically began pulling piles of pine needles off of the site, and digging sand out with my hands. It is very difficult to remove sand with your hands from under water. Needless to say, I found many *D. x hybrida* that had been smothered and rotted under the tightly packed sand. There are still a number of plants at that site, but it is not nearly as impressive as when I first saw it.

Since then, the land manager has insisted that the employees strictly follow instructions. As it turns out, the person who destroyed the site was told not to mow it, but decided to do it anyway. He has since been told to cover the trail with trees, and allow brush to grow back to protect the site from further harm.

The summer of 2017 is here and the plants are recovering nicely. Still not as many impressive clumps as before, but I am satisfied that they are safe. I have also planted numerous propagations of these plants in very nice habitat at a nearby preserve, with permission.

On July 10, 2012, I was searching a forested riverbank for rare orchids known at the site. The bank was a short but fairly steep slumping bank of a very fine silty-clay texture. Above it was a sandy hillside, below it the river. I started seeing the typical wetland plants, including all three species of *Drosera* from New Jersey. Then, a peculiar clump of *D. filiformis* caught my eye. I carefully made my way to the plant and found it was actually another *D. x hybrida* (Fig. 2)! This was only one small clump of about 10 crowns, but it was another new occurrence. I was thrilled. I soon saw the same pattern of disturbance. This time, however, instead of vehicles causing it, it was the slope of the hill, and the looseness of the soil. The slumping of the crest of the bank brought the *D. filiformis* that were growing up there, down to the *D. intermedia*, on the bank itself. These two species regularly grow together throughout their range without hybridizing. It must be something in the disturbance that breaks either a physical or temporal barrier to reproduction.



Figure 3: The solitary clump of *D. x hybrida* is in the lower left of the left photo (arrow), appearing shorter and denser than the surrounding *D. filiformis*. This is essentially the search image I look for when in the field. A closer view of the single clump found at this disturbed site (right).

I returned to this site several weeks later, I found several pieces of the plant had washed down the bank and were rooted in at the water’s edge in the mud. I collected these tiny plants and still have these as well. Again, I am glad that I did. The summer of 2013 saw quite a bit of rainfall. This river swells with the spring floods anyway, but this year was exceptional. The spot where the *D. x hybrida* was growing was under at least 60 cm of water for almost three months without reprieve. I thought for sure the plant would have been scoured off of the bank. Thankfully, as the water receded and I returned to check the plant, it held on tenaciously and was still growing. The other young divisions below were gone. On the one return trip I made in 2014, I found that the original plant had either died, or fell off of the bank and washed downstream. Only one tiny division remained with two crowns, growing about half way down the bank. While this site technically is still an extant occurrence, it is a very tenuous one, and most likely will be lost to natural flooding and erosion.

The above two sites are both in Burlington County, New Jersey. The remaining four that I have found so far are in Ocean County, New Jersey.

The first site was a sandy power-line cut that was regularly used for military maneuvers from one of the many military training areas in the Pinelands. I now had the *D. x hybrida* “bug” and was searching this site because the site had both parent species and regular disturbance from vehicles all over the plants. After quite some time, and a very sore neck, I did finally locate yet another single clump of plants (Fig. 3). The clump is just a few centimeters away from the main tire tracks in an area carpeted with both species. Everything was in place and it did not disappoint. I have looked for more plants at this site, and there well may be more, the cover of both species is vast. As of this writing, no other plants were found there.

On July 18, 2014, I was on the hunt again. This time at one of my favorite sites in the Pinelands, a large expanse of pure white sand dunes, spotted with wet seeps and streams. This area has the largest and densest cover of *D. filiformis* I have ever seen. Unfortunately, this site will be developed and turned into very high-income housing and storefronts. Currently, it is an illegal ORV park with

any wet or open area being regularly trashed by destructive use of off-road vehicles. Again, as we have already seen, this disturbance seems to be the key for making *D. × hybrida* possible, at quite a big cost however.

In the rutted bed of a severely damaged fen, I found another patch of plants. On the edge of this wet “trail”, I found an area with a few dozen small clumps of *D. × hybrida* spread around from the tire ruts to the forest edge about 2.5 m away (Fig. 4). Though each clump was small and isolated from each other, this edge was often assaulted by fast-moving vehicles causing powerful splashing and erosion of the bank. My guess is that the *D. × hybrida* here are of a single original plant that has been routinely broken up and scattered by the riding/splashing. But of course, there may be more than one genet here, this is just my guess based on what I see.

At the same area on August 16, 2015, but quite a good distance from this first site, I found another grouping of *D. × hybrida* (Fig. 5). Following the same stream, it opens up rather quickly to a very wide flat open expanse of permanently wet sand. There is very little plant



Figure 4: One of the attractive *D. × hybrida* clumps found in the tire ruts of this wet ORV trail.



Figure 5: One of the groupings of *D. × hybrida* found late in the year, and beginning to senesce for the coming dormancy.



Figure 6: You can see *Drosera filiformis* leaning over caused by the ORV's riding nearby and splashing the plants, knocking them over. This may be one way that the spatial separation of the species could break the reproductive barriers to hybridization. It is not very hard to think that such a disturbance may stress the plants or damage the emerging flowers, potentially delaying the bloom time, breaking down the temporal barrier to hybridization.

life left here due to the ORV use, but what is present is a fair number of both *D. filiformis* and *D. intermedia* (Fig. 6). The closer you get to the edge of the riding area, the more abundant the plants become, and you start getting a good cover of 3 different *Lycopodiella* (clubmoss) species, *Schizaea pusilla* (little curlygrass fern), *Pogonia ophioglossoides* (snakemouth orchid), and a good number of other interesting species. The area I am speaking of is the less disturbed area that is sandwiched between the xeric sandy dunes and the flat wet sandy area that is nearly devoid of the plants that once grew there. This zone is moderately disturbed, but largely intact. In the low vegetation, there was *D. × hybrida*, almost hidden amongst the mosses and grasses, but still unmistakable. There were several robust clumps scattered in this area of about 1.5 m squared.

On May 26, 2017, I found one additional small clump of *Drosera × hybrida* (Fig. 7). I had again targeted a site with a lot of disturbance. This time it was a power line where off-road vehicles had eroded the environment and left a lot of open wet areas. These areas are rimmed with *Drosera*, and like the other sites, these plants are repeatedly run over or disturbed by splashing as vehicles pass. As you can see, this clump is not very impressive. But it is the sixth new site where I have been able to find *Drosera × hybrida* in the wild.

It has been a great deal of fun finding these plants in the wild and being able to see the context in which they occur. Lots of hours spent in the Pinelands of southern New Jersey searching for these gems has rewarded me with a number of other interesting and beautiful finds. My hope for the future of this plant is to find that it has naturally gone tetraploid and reproductively successful in



Figure 7: This is the most recent occurrence of *Drosera* × *hybrida* that I have found. To date, this small clump is number 6 in my ongoing search for this natural hybrid.

the wild, not just in collections. Additionally, I would like to find *D.* × *hybrida* in North Carolina at one of the few small sites where *D. filiformis* still occurs. Finding the analog of *D.* × *hybrida* among the all-red *Drosera* in the Florida Panhandle would be very exciting as well. Here’s to hoping and exploring!

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THE CORRECT NAME FOR *DROSERA INTERMEDIA* × *D. ROTUNDIFOLIA*

JAN SCHLAUER • Zwischenstr. 11 • 60594 Frankfurt/Main • Germany • jan@carnivorousplants.org

Schlauer & Fleischmann (Taxon 65:390, 2016) proposed to conserve the name *Drosera* × *belez-eana* Camus (frequently misspelt ‘*beleziana*’) with a conserved type in a sense that would allow continuation of its use for the hybrid *D. intermedia* Hayne × *D. rotundifolia* L., as intended by the original author (Camus, Journal de Botanique (Morot) 5: 196-199, 1891). However, the identity of the type specimen deposited by Camus at Paris (P04963231) is a specimen of *D. rotundifolia* and not of the hybrid. This proposal was declined at the last International Botanical Congress in Shenzhen, China (Wilson, Taxon 66: 742-744, 2017). Based on the verdict “most of the Committee were not convinced that the name was used widely enough to make its replacement by *D. ×eloisiana* T.S.Bailey disruptive” (Applequist, Taxon 66: 500-513, 2017; but cf. Brittnacher, Carniv. Pl. Newslett. 44: 194, 2015). This means from now on *D. belezeana* is nothing else but a synonym of *D. rotundifolia* and must not be used for the hybrid. The correct name for the hybrid is *D. eloisiana* (Bailey, Planta Carnivora 37(1): 42-47, 2015).



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ERRATUM
FIELD NOTES FROM ANDALUCÍA, SPAIN - REVISITED

JAN SCHLAUER • Zwischenstr. 11 • 60594 Frankfurt/Main • Germany • jan@carnivorousplants.org

The presence of *Pinguicula mundi* in north-eastern Andalusia, Spain, was reported (Schlauer 2015: 151, fig. 5, left) as a range extension of this taxon. The identification of the plants was based on leaf morphology of flowering individuals observed in late April, 2013. According to observations at the same site (Oliver Gluch & Peter Harbarth, pers. comm. 2017) the plants develop much longer leaves later in the season (mid May, 2017, cf. Fig. 1) while still in flower. This suggests the plants are in fact unusual *P. vallisneriifolia* (usually *P. vallisneriifolia* has much longer leaves already at early anthesis, as observed at the same time north and south of the mentioned locality) rather than *P. mundi*, which does not develop longer leaves even after anthesis.

Schlauer, J. 2015. Field notes from Andalucía, Spain. Carniv. Pl. Newslett. 44: 146-152.



Figure 1: Unusual *Pinguicula vallisneriifolia* with long leaves appearing comparatively late in flowering time, Sierra de Segura, Spain. Photo by Oliver Gluch 2017.



NEW CULTIVARS

Keywords: cultivar, *Dionaea muscipula* ‘Red Pico-Teeth’, *Heliamphora* ‘Patasola’, *Nepenthes ampullaria* ‘Black Miracle’, *Nepenthes ampullaria* ‘Black Pearl’.

Dionaea muscipula ‘Red Pico-Teeth’

Submitted: 16 July 2017

Dionaea muscipula ‘Red Pico-Teeth’ was obtained as a seedling from Lucien Blacher in December 2013. The entire plant is dark red and the leaves are prostrate rather than erect (Fig. 1). The traps have extremely short, even non-existent teeth — as opposed to *D.* ‘Red Micro-Teeth’ and other cultivars that have larger teeth.

The name is derived from this cultivar being all red and pico (for picometer) refers to the traps having extremely short or non-existent teeth.

This plant should be reproduced only by vegetative means to ensure that its unique characteristics are maintained.



Figure 1: *Dionaea muscipula* ‘Red Pico-Teeth’ plant and trap.

—SÉBASTIEN BONNET • 20 hameau des NoëlS • 10000 TROYES • France • bonnet.troyes@free.fr

Heliamphora ‘Patasola’

Submitted: 18 June 2017

Heliamphora ‘Patasola’ (Fig. 2 and Back Cover) is a hybrid *H. parva* × *folliculata* that I created several years ago. It is unique among its siblings based on its vigor, rapid growth rate, and unique physical characteristics. It grew from seed to flowering adult in under four years. Jennifer Lei cultivated this particular seedling to maturity.

Mature pitchers are 25-30 cm tall and 5-6 cm wide. Under intense lighting, the pitcher color will become vinaceous to violet to almost charcoal as the pitcher ages. Pitcher shape is infundibular in the lower part with a pronounced waist approximately half way up. The upper section is infundibular and slightly compressed in older pitchers from front to back. This compression gives the pitcher



Figure 2: *Heliamphora* 'Patasola'. Photo by Butch Tincher.

mouth a kidney or reniform shape when viewed from above. The interior and exterior surfaces of the pitcher are puberulent to pubescent.

The rim of the pitcher mouth may undulate under some conditions and become revolute as it approaches the base of the nectar spoon. The revolute rim ends at the nectar spoon with little to no further constriction. The nectar spoon is helmet shaped with the bottom edge diagonally tapering to a point at the apex. It is a copious producer of nectar with droplets sometimes observed on the nectar spoon and exterior pitcher surface.

The inflorescence is pubescent with typical *Heliamphora* flowers. Productive bracteole nectaries have been observed under favorable conditions

The Patasola or “one foot” is one of many myths in South American folklore about female monsters from the jungle, appearing to male hunters or loggers in the middle of the wilderness when they think about women.

Heliamphora 'Patasola' must be reproduced vegetatively by rhizome division or cuttings to preserve the characteristics of the cultivar.

—BUTCH TINCHER • London • Kentucky • USA • butch.tincher@kctcs.edu

—JENNIFER LEI • San Jose • California • USA • pokie22@gmail.com

Nepenthes ampullaria is a widespread species of lowland *Nepenthes* that occurs in Peninsula Malaysia, Borneo, New Guinea, Singapore, Sumatra, Thailand, and the Maluku Islands. Over the entirety of its range, *Nepenthes ampullaria* shows spectacular diversity in pitcher coloration, even though morphologically there is very little variation. These color varieties are stable in both the field and cultivation. Jacky Chiêm of Chiem Exotics, a retail Carnivorous Plant Nursery in Vietnam, has amassed a collection of over 70 different clones. These are two of the most brilliant and are described as cultivars.

Nepenthes ampullaria ‘Black Miracle’ has been in cultivation, in Asia in particular, for the past 5 years at least and in the author’s opinion is worthy of cultivar status. This striking clone was believed to have been collected in Indonesia and cuttings were provided to a number of nurseries in Thailand who have propagated and distributed this plant under the name “Black Miracle”. The pitchers attain a solid dark brown, almost black, coloration with a peristome that has varying amounts of green and black striping (Fig. 3 right). The true ‘Black Miracle’ has black markings on the leaves as well (Fig. 4 bottom), making it a truly unique clone of *Nepenthes ampullaria*.

Nepenthes ampullaria ‘Black Pearl’ is another of the select clones from Chiem Exotics. This clone was selected for cultivar status because of the striking pure dark brown to black coloration of the pitchers and peristome (Fig. 3 left), giving it the luster of a black pearl. Unlike *N. ampullaria* ‘Black Miracle’, this cultivar does not have black markings on its leaves (Fig.4 top).

Both of these cultivars can only be propagated by cuttings from the original clones.

—RICHARD NUNN • Malvern • South Australia • richardjnunn1@gmail.com



Figure 3: Left, the almost pure brown/black pitcher of *N. ampullaria* ‘Black Pearl’. Right, the striking green and black striped peristome of *N. ampullaria* ‘Black Miracle’.



Figure 4: Top, *N. ampullaria* ‘Black Pearl’ produces typical green leaves. Bottom, the leaves of *N. ampullaria* ‘Black Miracle’ have characteristic black markings.

